NeSS E&O Working Group Summary Report

Education and Outreach E&O Working Group

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The E&O Working Group was charged with the task of assessing and envisioning the E&O opportunities associated with neutrino and subterranean science. The Working Group participants included "E&O liaisons" from each of the other Working Groups and other individuals recommended by the Working Group Leaders. The participants already are engaged in significant E&O efforts associated with NeSS, and have the vision and energy to make these efforts even more effective. Many participants gave talks describing a key E&O activity. The E&O Liaisons gathered information and ideas from their science groups and presented these to the E&O group. Short biographical statements of participants, plus abstracts and [need link here] complete versions of these talks are available on line.

Based on the themes that emerged from these talks, extensive group discussion, and other relevant documents provided by the participants, we envision that NeSS E&O will:

> *Develop and foster an arena of accessible resources, including opportunities and information, in which educators, students, and the public can experience working science facilities in ways that further their knowledge about, understanding of, and attitudes toward science and technology.*

The members of the E&O Working Group believe that, were we forced to function in the "add-on" conditions under which the vast majority of E&O programs are planned and funded, it would not be possible to achieve this ambitious vision. Operating under "add-on" conditions entails serious constraints that often result in E&O programs that:

- are unfocused and uncoordinated in their goals and program strategies;
- cannot offer the sustained programming that fosters faculty and teacher investment;
- operate with little if any of the benefits provided by evaluation and benchmarking;
- are unable to address key workforce issues; and
- generally are not able to optimize the use of scientists' and teachers' time and effort.

However, we believe that we will be able to realize our vision because NeSS E&O programs are being planned not as an "add-on," but from the ground up—as an integral part of the proposed and existing NeSS facilities. These facilities are especially promising for E&O programs due to the following five factors:

1. Ground-up coordinated context: NeSS E&O activities will occur within a "built in from the beginning" context. This context will enable an integrated set of projects to be:

- selected in order to realize a well-defined set of goals (including the key goal of diversifying and developing the national science workforce);
- located in appropriately designed and resourced environments;
- of sufficient duration to engage the commitment of scientists, teachers and other key constituents; and
- implemented efficiently by trained staff who will:
  - connect proposed and existing program elements and systematically build on existing infrastructure,

- design programs that effectively foster understanding of the process of science and are aligned with state and national science standards, and
- seek to maximize human and other resources in light of evaluation findings and lessons learned from similar activities nationally.

Our E&O programs will provide immersion-based professional development in science for *pre-college educators* in hands-on, inquiry-based, learn-by-doing ways. Training in teaching methods and pedagogies for *college educators, scientists, graduate students, and post-docs* also will be an important part of the collaborative science and education endeavor. Research opportunities will be provided for *undergraduate college educators* who normally are not afforded the resources to conduct research through their home institutions. The NeSS facilities will offer ongoing opportunities for educators and *undergraduate students* to participate in and generate research experiments in collaboration with the facility-based scientists or in independent settings.

2. Fundamental origins questions pursued in remote and extreme frontier environments: Able to exploit the excitement of pursuing fundamental questions in remote and extreme venues, the NeSS E&O programs promise to be unusually compelling and "contagious" for teachers, students, and the public. Outreach will not only inform the public about the science that is happening but also excite individuals about the potential for discovery in these frontier environments.

3. Cutting-edge multidisciplinary science: The cutting-edge multidisciplinary nature of the NeSS facilities affords their E&O offices unparalleled opportunities to develop high quality programs that build on the resources of several disciplinary communities and that open exciting opportunities "at the intersection of disciplines" for students and scientists as well as K-12 teachers.

4. Collaborative multi-site effort: The E&O activities will be developed and implemented in ways that draw from the resources of the multiple NeSS sites, avoid redundancy and achieve synergy and, in turn, strengthen the already emerging inter-institutional and inter-facility collaborations among NeSS scientists.

5. Facilities located in areas inhabited by underserved populations: The location of the NeSS facilities affords us the opportunity to work especially hard on understanding and meeting the needs of under-targeted, underserved groups—rural people, and Native Americans. Moreover, the network among NeSS facilities will provide access to effective professional development to teachers in rural, urban, and/or suburban areas and teachers in districts with high minority enrollment. Thus, we can work in a sustained and strategic manner to meet the need to increase the proportion of U.S.-born youth, especially those from under-represented groups, in the science workforce.

Overall, with these scaffolds in place, the ability to communicate to teachers and the public the excitement and process of science becomes reality. This approach facilitates the connection of cutting-edge science with education by optimizing the use of limited education and outreach resources.

Recommendations

Given the opportunities afforded by the NeSS facilities we offer the following recommendations.

With regard to *organization and infrastructure*, we propose that:

- NeSS E&O use a "coordinated semi-independent projects" organizational model, and use an "E&O Projects Advisory Committee" (PAC) to review the education and outreach components of all experiments proposed for NeSS, much like PACs already operate in reviewing science proposals at national labs;
- E&O staff work with NeSS scientists to provide resources in the development of experiment-led E&O opportunities;
- the E&O offices include staff who are familiar with the research literature about how to optimize the use of scientists' time in E&O activities; and
- the E&O activities are integrated into the budget structure of the facilities in a manner that ensures long-term funding and sustainability.

With regard to *overall guiding principles* for developing E&O programs, we propose that the E&O programs:

- develop a sustained teacher-scientist network;
- build onto the infrastructure of existing E&O programs, such as TEA, Quarknet, the Timbuktu Academy, and so forth;
- utilize "bottom-up/top-down" strategies that introduce scientist to issues of education while at the same time introducing educators to science processes and content;
- maximize the effective transfer of knowledge though interactions of "near peer" groups (e.g., graduate to undergraduate students);
- match the strengths and talents of individual scientists to the interests of various audiences;
- seek input and support from community leaders, where appropriate, and particularly from ethnic minority groups in geographic areas near NeSS facilities; and.
- encourage university administrators to support and reward faculty who engage in E&O activities.